

Before the
FEDERAL COMMUNICATIONS COMMISSION
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FEDERAL COMMUNICATIONS COMMISSION
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In the Matter of

1998 BIENNIAL REGULATORY REVIEW—

ET Docket No. 98-80

**Conducted Emissions Limits Below 30 MHz for
Equipment Regulated Under Parts 15 and 18 of
the Commission's Rules**

EX PARTE COMMENTS OF MICROSOFT CORPORATION

Over the past few years, wireless technologies have changed the way Americans live and work. Wireless consumer products — from cell phones to cordless baby monitors — have improved the quality of life of millions of Americans. These products have become so important in recent years largely because they have become accessible to a mass market. Advances in manufacturing techniques and smart spectrum management by the Commission have enabled companies to offer wireless products and services to consumers at affordable prices.

Microsoft submits these *ex parte* comments to inform the Commission of a new class of wireless devices that have the potential to bring the advantages of low-cost computer networking to the consumer market.¹ Due to new developments in integrated circuit fabrication processes that have enabled single chip transceiver systems, Wireless Connectivity Equipment (“WCE”)

¹ The Commission released a Notice of Inquiry (“NOI”) in this proceeding in June 1998. *Notice of Inquiry* (released June 8, 1998). Microsoft responded to the NOI by submitting comments that addressed the Commission’s conducted emissions rules as they pertain to carrier current systems emitting RF energy in the frequencies below 30 MHz. Comments of Microsoft Corporation (filed July 27, 1998). We submit these *ex parte* comments to supplement the record regarding the impact of the Commission’s conducted emissions rules on the development of Wireless Connectivity Equipment.

can now provide connectivity for the home at very low cost. Unfortunately, the Commission's conducted emissions rules currently pose the principal hurdle to marketing these new products. Microsoft therefore submits these *ex parte* comments to ask the Commission to modify its Part 15 rules for the purpose of enabling consumers to access and enjoy the benefits of this new technology.

Part 15 WCE will allow consumers to take advantage of connectivity without incurring the substantial expense of wiring homes. It is reliable, inexpensive, and capable of transmitting and receiving data on the order of 20 Kbps. Among other things, WCE will allow consumers to use remote control keyboards and other input devices, transfer files among computers, and establish wireless connections for computer peripheral equipment such as printers. It will also support new computer gaming applications.

Unfortunately, Microsoft's product testing reveals that WCE will usually cause the PC or IT equipment to which it is attached to fail the conducted emissions test mandated by section 15.207 of the Commission's rules.² If the Commission slightly relaxes those limits in a small portion of the spectrum between 450 kHz and 30 MHz, however, low-cost WCE could be introduced to the consumer market. In particular, the Commission would best promote WCE by relaxing its conducted emissions rules in the 26.96-27.28 MHz band. Doing so will give consumers access to low-cost WCE but *will not cause harmful interference to other users of the spectrum*.

² 47 C.F.R. § 15.207.

I. Relaxation of the Conducted Emissions Limits at 27 MHz Will Not Adversely Affect Other Users of the Spectrum

To bring about a new market for WCE, the Commission must relax the conducted emissions limits at 27 MHz. The principal users of this spectrum are CB Radio operators who transmit on twenty-eight channels between 26.965 and 27.285 MHz.³ Within this frequency range, however, there are five 20 kHz channels that have not been allocated to CB Radio. WCE can therefore transmit on these channels without causing harmful interference to CB Radio. Even if WCE were to operate on the other channels in the band, it could avoid any CB operators in the area by searching for a clear channel and dynamically keeping track of which channels are used. In addition, the transmitters will emit only 5 mW of power. Such a low power device will not cause harmful interference to CB Radio transmissions, even if a significant portion of the signal were conducted back into power lines.⁴

II. WCE Cannot Operate Effectively Under the Current Conducted Emissions Rules

Microsoft's testing demonstrates that WCE transmitters will cause the IT equipment to which they are attached to exceed the Commission's current 250 uV conducted emissions limit. The limit is generally exceeded by 6 to 20 dB. Those tests are illustrated in Figures 1 and 2 below. The results are highly variable because the emissions depend on many factors such as the distance from the transmitter to the PC chassis or line cord, the length of the PC line cord, and the distance from the transmitter to the ground plane. The problem can be viewed in terms of the

³ 47 C.F.R. § 95.625.

⁴ In addition, the Radio Control ("R/C") Radio Service has been allocated spectrum in the band. The R/C frequencies are used by operators of model airplanes and boats and other radio controlled devices. As with CB Radio, WCE can avoid interfering with this limited service by employing clear channel searching. Moreover, interference is no more than a hypothetical issue given the low power of the WCE signal.

attenuation required between the voltage applied to the transmitter antenna terminals and the maximum conducted emissions limit (which is 250 uV). Transmitting at 27 MHz, a small loop antenna of approximately 12-cm diameter requires a drive voltage of 7.1 volts RMS to achieve the field strength of 10,000 uV/m at 3m permitted by section 15.227.⁵ This represents a factor of 28,400 or 89 dB attenuation between the radiated field of the antenna at 27 MHz and the conducted emissions limit at 27 MHz. This attenuation will cause the equipment to fail the conducted emissions test if the transmitter is close to an unshielded AC power cord. As demonstrated by the Figure 1, 0.1 pF of stray capacitance to the line cord will cause the equipment to fail by 27 dB.

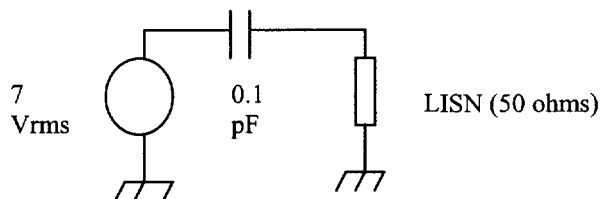
Figure 1:

Relationship Between Voltage Applied to Antenna and Conducted Emissions

$V(\text{conducted}) = V(\text{antenna}) * (50 \text{ ohms}) / Z(0.1 \text{ pF})$; 50 ohms is LISN impedance

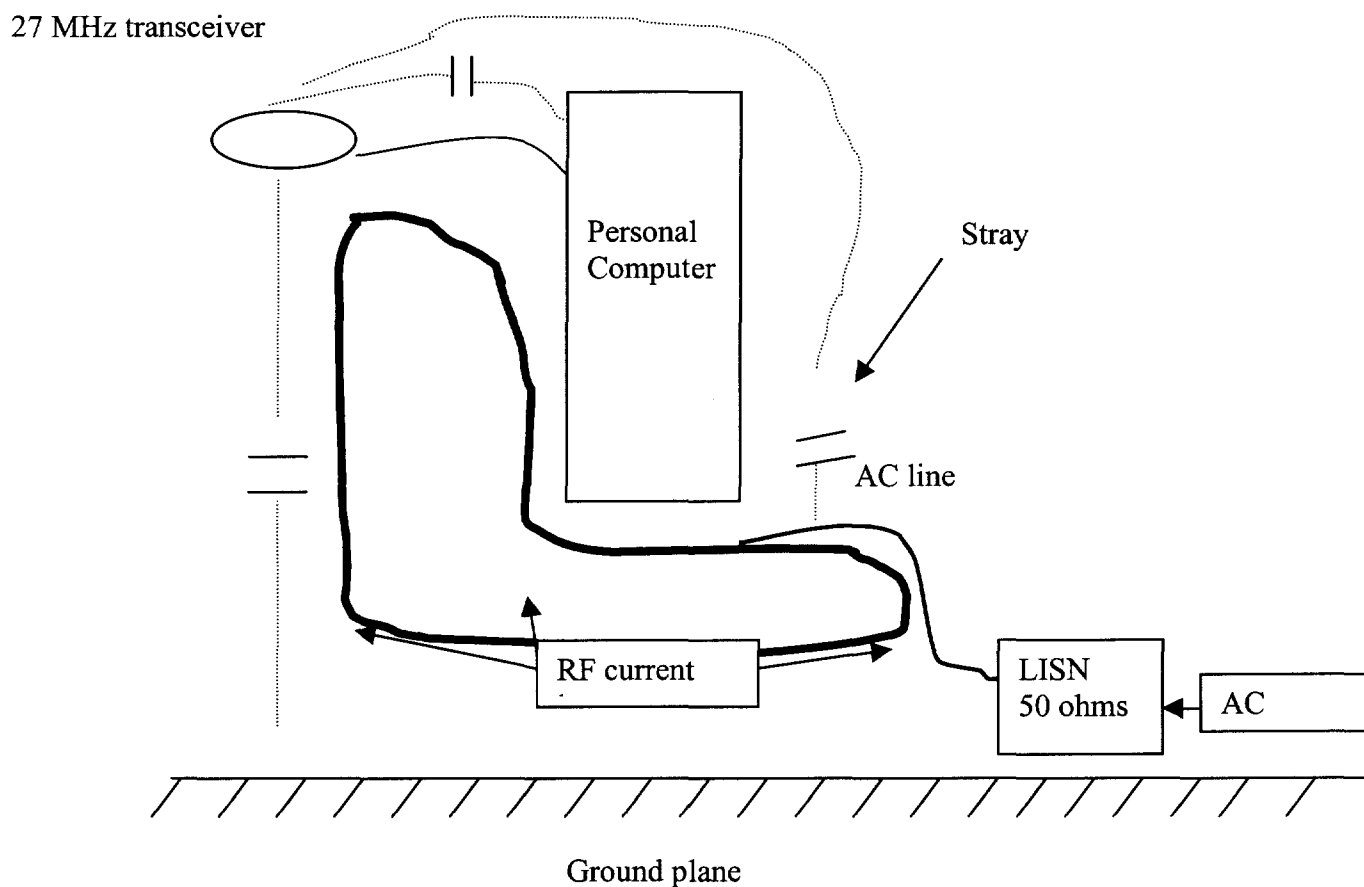
$Z(0.1 \text{ pF}) = 58.9 \text{ k ohms @ } 27 \text{ MHz}$

$V(\text{conducted}) = 7 * (50 / 58.9K) = 5938 \text{ uV or } 75.5 \text{ dBuV}$; limit is 250 uV or 48 dBuV, fail by 27.5 dB.



⁵ 47 C.F.R. § 15.227.

Figure 2
Conducted emissions test setup for WCE



III. None of the Alternatives to Relaxing the Conducted Emissions Rules Are Practical

There are several theoretical alternatives to relaxing the conducted emissions limits. None of these alternatives, however, will resolve the issue and facilitate mass-market introduction of affordable WCE.

- 1. It is not practical to use frequencies above 30 MHz for low-cost equipment*

The first alternative would involve using a different portion of the spectrum, outside of the bands 450 kHz to 30 MHz at issue in this proceeding. The rules governing operation in the 49 MHz, 915 MHz, and 2.4 GHz bands allow adequate radiated power output for devices

connected to a personal computer to achieve a range of 5-10 meters with a small antenna. However, operation in each of these bands is not now practical. Only 80 kHz of spectrum is available in the 49 MHz band in the United States, and many countries would not permit any operation of WCE in the band. Similarly, spectrum is not available internationally at 915 MHz. In addition, components for use at 915 MHz are still very expensive. Operation at 2.4 GHz would require even more expensive equipment that is currently not available. Moreover, the power consumption needs at this higher frequency would be incompatible with designing a low-cost peripheral device.

The frequencies below 30 MHz provide the only practical alternative for low-cost WCE. In particular, the 27 MHz band is singularly attractive because there is a relatively large amount of spectrum available (320 kHz) that could accommodate several wideband channels. In addition, it is one of the few frequencies on which international operation is possible. Worldwide availability of a frequency allows manufacturers to take advantage of economies of scale, which ultimately benefits consumers. Products are cheaper to manufacture when the same models can be used globally.

2. *It is not practical to require the use of shielded AC power cords*

The second alternative to relaxing the conducted emissions limits might involve requiring the use of shielded AC power cords. This alternative is also impractical, and would greatly add to the complexity of marketing these products. PC peripheral manufacturers do not determine which power cord a PC manufacturer bundles with its equipment. The success of low-cost WCE would therefore depend on whether PC manufacturers decide to incur the added expense of incorporating shielded power cords into their systems. Moreover, adding WCE functionality to an existing PC system without a shielded power cord would be unduly complicated, if not

impossible. In addition, given the variety of factors that influence the RF emissions, shielding the AC power cord would probably not fully address the problem.

3. *It is not practical to use expensive filters*

The only methods available to break the RF current loop between the transmitter, the power cord, and ground are to use exotic common mode filters on every signal and power line, or to employ optical and transformer isolation techniques. For example, a 27 MHz transmitter connected to a PC via the Universal Serial Bus (“USB”) must pass data and clock signals at 12 MHz without distortion and attenuate the 27 MHz common mode signal by 40 dB or more. These two frequencies are slightly more than an octave apart, requiring unreasonably complex high order filters on every connection to the transmitting device. This configuration would be both difficult and expensive to implement. Therefore, if complex filtering were required, WCE would be developed for a limited market rather than as low-cost peripheral equipment for use by the general public. Since the technology has multiple mass-market applications, the public interest would certainly be promoted if the Commission relaxed its conducted emissions limits instead of requiring the use of cumbersome and expensive filtering.

IV. Conclusion

In the NOI, the Commission asked for comment on whether the current conducted emissions rules “impede the introduction of new technologies.”⁶ The short answer is “yes.” The current conducted emissions rules are incompatible with the introduction of inexpensive WCE. Slightly relaxing the conducted emission limits in the 27 MHz band would adequately address the problem. Such a change would not adversely affect any other users of the spectrum, but

⁶ NOI, at ¶ 13.

would enable manufacturers to bring the potentially enormous benefits of inexpensive WCE to U.S. consumers. In the interest of maximizing use of the nation's spectrum resources, the Commission should therefore propose and adopt new rules as expeditiously as possible.

Respectfully submitted,

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